The Ichthyogram

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Fish Feed: To Sink or to Float, That is the Question

Floating feed has recently become readily available in Utah in quantities that may make their use in Utah state hatcheries more feasible. Floating feeds have been used for years in the catfish industry and are desirous because the fish can consume the pellets before they sink to the bottom of the pond or raceway where they may remain uneaten. This process allows the fish more time to consume a ration of food which may result in better feed conversions and less pollution. These qualities would be beneficial in trout hatcheries that are coming under pressure to not only reduce pollutants in their effluent but to maintain a steady output of fish.

A feeding trial was conducted at the Fisheries Experiment Station to compare floating feeds with the traditional pelletized sinking feed and to evaluate differences in fish performance between the two.

In November, Bear Lake cutthroat (5.1 g/fish) were stocked into each of nine raceways (35' x 4') at densities of 3,214 fish per raceway. All treatments were inventoried monthly and necropsies performed bimonthly. The original density index was 0.31 (as defined by Piper et al., 1992). Densities were adjusted whenever the index approached 0.4 by moving tail screens further down the raceway. Water was supplied by a well at a temperature of 13° C.

Fish were fed under three different feeding regimes: floating feed by hand (FFH), floating feed by demand feeder (FFD), or sinking feed by hand (SFH). Fish were originally fed at 2.6% of body weight, but this ration was cut back to 1.8% because the demand fed fish had difficulty adjusting to the feeders. After 2-3 weeks the demand fed fish adapted to the feeders and after that point all treatments received approximately 2.0% through the course of the study. At the start of the study the floating feed used was a steelhead formulation (45% protein, 16% fat) and the sinking feed a salmon formulation (48% protein, 15% fat). Because of problems in getting the steelhead diet, the floating feed treatments were switched to a trout formulation with lower protein (40%) and fat (10%) after two months. The sinking feed treatment was also switched to a trout formula several days after that.

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Weight gain was not influenced by feed type or feeding method. For the first two months of the study (Nov and Dec) the FFD fish were significantly smaller than either the FFH or sinking SFH fish. However, by the end of this 18 week study they caught up with the other two groups and final total weight gains or specific growth rate were not significantly different among treatments (see Table 1). This information reflects the observations made about the FFD group requiring time to adapt to the demand feeders. The FFD fish consumed significantly less feed, on a g/fish basis, than either of the other treatments and also had a significantly better feed conversion than the FFH or SFH. The feed costs per pound of fish produced were similar for all three treatments, $ 0.37 for both floating feed treatments and $ 0.38 for the sinking feed treatment.

Information collected from the routine necropsies (Health Condition Profile; Goede and Barton, 1990) reflected possible treatments effects. Scores from the mesenteric fat index which range from 0, or no fat, to 4, the highest possible score, showed the FFH group with the best score, 2.2, followed by the FFD group, 2.0, and finally the SFH group, 1.4. And as might be expected, fin wear was much lower among those fish fed by demand feeders compared to the two hand fed groups. All other indices of fish health as defined by the HCP system were similar among the three treatments.

The results from this study indicate that floating feed, fed either by hand or demand feeders, may be an acceptable alternative to the traditional sinking pellets in the culture of cutthroat trout. Growth was not influenced by feed type or feeding methodology and in fact feed conversions were best for the FFD group, although this may be an artifact of using demand feeders. In some situations a floating feed may be more desirous than the sinking type. Because the floating feed retains it shape, even after being in the water for many hours, uneaten feed can be more easily

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Table 1. Comparison of hatchery performance of cutthroat trout fed either a floating or sinking pellet by hand or demand feeder.

	Floating Feed Hand Fed	Floating Feed Demand Fed	Sinking Feed Hand Fed
Final Fish Weight (g/fish)	37.3 ± 0.2	40.5 ± 2.9	37.6 ± 0.3
Total Weight Gain (g/fish)	32.3 ± 0.2	35.4 ± 2.9	32.5 ± 0.3
Specific Growth Rate (g/fish/day)	0.67 ± 0.00	0.69 ± 0.02	0.67 ± 0.00
Total Amount Fed (g/fish)	27.4_a ± 0.3	24.4_b ± 1.2	27.1_a ± 0.7
Feed Conversion Ratio	0.85_a ± 0.01	0.69_b ± 0.03	0.83_a ± 0.02
Feed Cost per Pound Fish Produced	0.37 ± 0.00	0.37 ± 0.02	0.38 ± 0.01

Laboratory Report: Use of a One-day Giemsa Stain for Detection of *Myxobolus cerebralis* in Cranial Cartilage of Salmonids

Current diagnostic methods for the detection of *Myxobolus cerebralis*, the causative agent for whirling disease of salmonids, include both the detection of spores by conventional methods such as the plankton centrifuge or pepsin-trypsin digest and confirmation by the observation of characteristic lesions by histopathology. Frequently, samples obtained in the field are frozen and held in cold storage for processing at later dates. Due to damage to soft tissues by the freezing process, pathologists rely on lesions in cartilage or bone along with the presence of myxosporean parasites to confirm the presence of "whirling disease". Sections are often stained with Giemsa to enhance the detection of spores. The Giemsa stain commonly used in histology for the spores is a two day stain.

In Vol. 18, No. 4, December 1995 of *The Journal of Histotechnology* is an article entitled "Microwave Giemsa Technique for Paraffin Embedded Tissue Sections" by Charles J. Churukian*. This is a one day stain and was tried on sections previously confirmed positive with *M. cerebralis*. The results have shown this technique to be equal or superior to the two day method.

One change was made in the technique as described in the journal. At the step where a glass coplin jar is placed in the microwave oven, heated to 58°C and the slides allowed to remain in this warm solution for 1 hr, an incubator is used instead. The incubator was heated to the 58°C temperature. The working Giemsa was placed in the incubator and heated to this temperature. The slides were placed in the stain and the incubator was turned off, leaving the slides to sit in the warm incubator for 1 hour.

The process also cuts down on time required for the 1% acetic acid procedure. The two day stain requires dipping each slide individually. With the new technique, all the slides are put in the 1% acetic acid for 5 seconds and then removed and rinsed in distilled water.

The use of this stain has resulted in considerable savings of time and effort in preparation of tissues for confirmation of whirling disease.

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removed and there is less chance of disintegrated pellets, common to the sinking feed, fouling the raceways and contributing to water pollution. Reducing the amount of disintegrated feed particles in a given raceway may also aid in the reduction of gill diseases. Fat levels were also higher in the two floating feed groups which may have implications to fisheries management programs.

To better address the relationship between feed type, floating vs. sinking, feed formulation, trout vs. salmon, and phosphorus content, low phosphorus diets vs. regular, a more comprehensive study is being planned. This will hopefully better define contribution of diet type and formulation to overall fish performance, cost of production, and pollution.
Ronnie Arndt

Phosphorus in Hatchery Effluent

Pollution in hatchery discharges has developed into an area of concern recently and several state hatcheries in Utah are facing restrictions on the level of pollutants in their effluent. To test the idea that using floating feeds may reduce phosphorus pollution in hatchery effluent, phosphorus analyses were made in conjunction with the floating feed study mentioned previously. Water samples from raceway tails were collected four times during three sampling days and analyzed for total phosphorus.

Phosphorus analysis of water samples revealed an interesting trend. The initial samples analyzed were taken in mid January and at the time effluent from the two floating feed treatments had significantly lower phosphorus levels than the sinking feed treatment (see Table 1). At that sampling time the floating feed fish had already been switched to the trout formulation but the sinking treatment was still being fed a salmon diet. To get a better comparison of phosphorus levels from similar dietary treatments, a second sample was taken two weeks after the first when all three treatments were being fed on trout formulations, sinking or floating. There were no significant differences between treatments for this sampling date, however in March the sinking feed hand fed (SFH) sample once again had significantly higher concentrations of phosphorus than either the floating feed hand fed (FFH) or floating feed demand fed (FFD) treatments.

The results from the phosphorus assays suggest that it may be possible to lower phosphorus levels in hatchery effluent by using floating feeds. Phosphorus concentrations were lowest for the floating feed treatments for two of the three sampling dates, and visual observations made by Doug Routledge and Quentin Bradwisch, our hatchery staff, suggested that algae and moss growth was more of a problem in those raceways fed the sinking feed. Overall, when looking at fish health, performance, and possible reductions in phosphorus pollution it appears that in given situations it may be advantageous to use floating feeds in the culture of salmonids. Additional studies are required however, to address the relationship between diet formulation and production method, on the output of phosphorus from a hatchery.

Ronnie Arndt

Table 1. Average[1] Daily Total Phosphorus Concentrations (mg/L) in Treatment Effluent for Three Sampling Dates

Time	Inflow	Floating Feed Hand Fed	Floating Feed Demand Fed	Sinking Feed Hand Fed
January[2]	$0.018_a \pm 0.004$	$0.036_a \pm 0.008$	$0.038_a \pm 0.013$	$0.073_b \pm 0.011$
February	$0.020_a \pm 0.002$	$0.042_b \pm 0.005$	$0.046_b \pm 0.025$	$0.051_b \pm 0.006$
March	$0.011_a \pm 0.002$	$0.042_b \pm 0.007$	$0.059_b \pm 0.011$	$0.086_c \pm 0.015$

1 $n = 4$, significant differences apply to a given month only

2 floating treatments switched from the steelhead to trout formula 2 days previous to sampling

Whirling Disease in Minersville Reservoir?

Division of Wildlife fish health officials at the Fisheries Experiment Station in Logan have announced the probable discovery of the discovery of *Myxobolus cerebralis*, the parasite that causes whirling disease in rainbow trout from Minersville Reservoir. The finding was made as part of a survey of state waters to discover the range of the parasite. Although spores resembling the parasite have been discovered in three samples, pathologists have been unable to confirm the disease due to a very light infection in the fish. Testing in previous years had failed to show any evidence of the parasite. Plans are underway to attempt to further confirm the presence of the parasite through use of polymerase chain reaction (PCR) techniques.

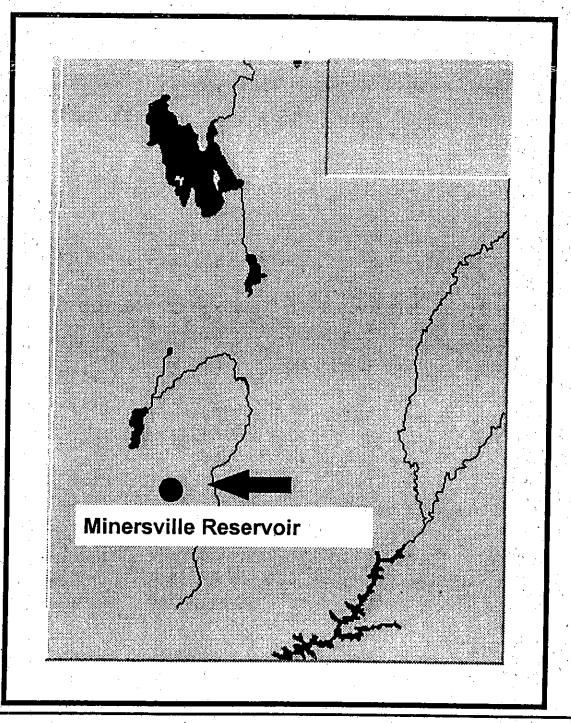
The source of the infection is not known. The drainage is rather isolated and is used intensively for summer irrigation. No fish culture facilities are located in the area. State hatcheries at Loa and Glenwood that stock the reservoir have consistently tested negative for the parasite and were found negative again in 1996 after the discovery at Minersville.

Minersville Reservoir is located near the town of Beaver in southern Utah. The reservoir is managed for trophy fishing and has become immensely popular with anglers in recent years. Southern region aquatic manager Dale Hepworth doesn't expect the finding to cause any noticeable impact to the fishing, because larger, less susceptible fish are stocked in the reservoir. Natural reproduction does not occur in salmonids at this fishery.

The spores of the parasite can easily be transferred on muddy boots, boats or float tubes from a contaminated site. Biologists caution anglers to be very careful and thoroughly clean off all mud and dry all fishing equipment after fishing at Minersville.

Whirling disease was first discovered in Utah in 1991 in the Fremont and Otter Creek drainages in southern Utah. It has also been found in the Bear River and Ogden River drainages of northern Utah.

Chris Wilson



Voice Mail at FES

For the sake of all those who love to hate voice mail messages, here are the voice mail extensions for personnel at the Fisheries Experiment Station: Ron Goede (17), Ronnie Arndt (20), Quentin Bradwisch (26), Ernie Dean (14), Nelma Gates (12), Debbie Kohler (17), Doug Routledge (16), Kent Thompson (13), Eric Wagner (22), Chris Wilson (21). The phone number is otherwise still the same at 801-752-1066.

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